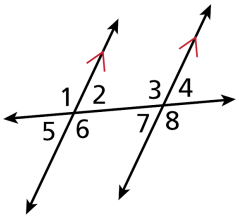
Attendance Problems.

1. Identify the the pair of alternate interior angles.



2. Use a calculator to find $\tan 30°$ to the nearest ten-thousandth.

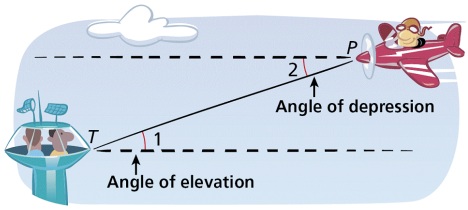
3. Solve $\tan 54° = \frac{2500}{x}$ Round your answer to the nearest hundredth.

I can solve problems involving angles of elevation and angles of depression.

Vocabulary	
angle of elevation	angle of depression

Common Core: CC.9-12.G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

And **angle of elevation** is the angle formed by a horizontal line and a line of sight to a point *above* the line. In the diagram, <1 is the angle of elevation from the tower *T* to the plane *P*.



An **angle of depression** is the angle formed by a horizontal line and a line of sight to a point *below* the line. <2 is the angle of depression from the plane to the tower.

Since horizontal lines are parallel, <1 || <2 by the Alternate Interior Angles Theorem. Therefore the angle of elevation from one point is congruent to the angle of depression from the other point.

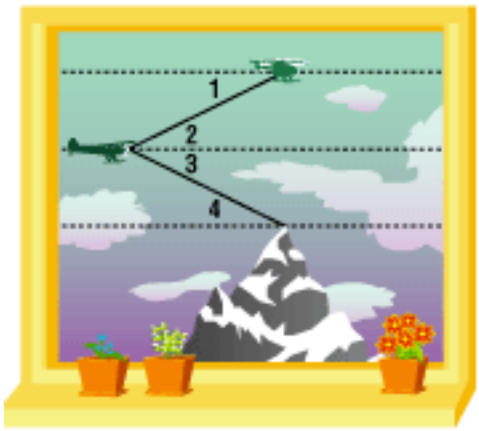
Q: Why do mathematicians dislike the beach?
A: Because they have to sine and cosine to get a tan!

"Take good care of your reputation. It will live longer than you do."—*Unknown*

<u>Video Example 1</u>. Use the diagram to classify each angle as an angle of elevation or angle of depression.

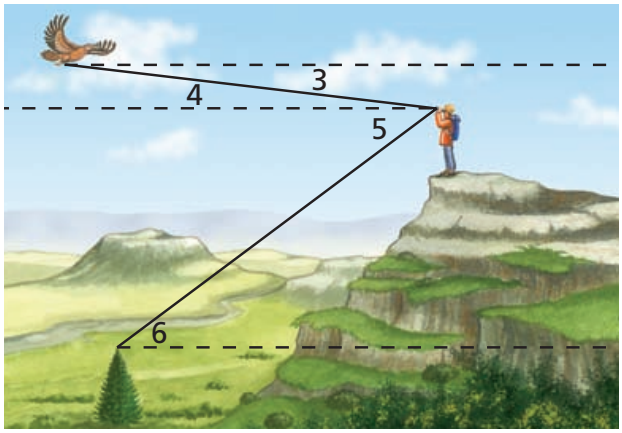
A. $\measuredangle 2$ **B.** $\measuredangle 3$

C. $\measuredangle 4$ **D.** $\measuredangle 1$



1 Classifying Angles of Elevation and Depression

Classify each angle as an angle of elevation or angle of depression.



A $\angle 3$

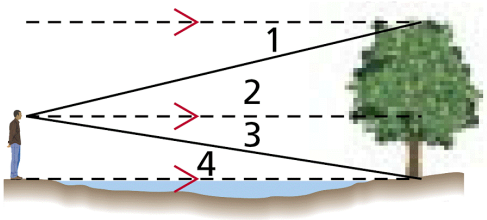
$\angle 3$ is formed by a horizontal line and a line of sight to a point below the line. It is an angle of depression.

B $\angle 4$

$\angle 4$ is formed by a horizontal line and a line of sight to a point above the line. It is an angle of elevation.

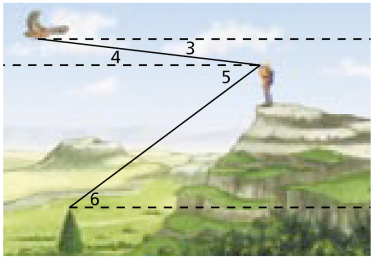
<u>Example 1</u>. Use the diagram to classify each angle as an angle of elevation or angle of depression.

A. $\measuredangle 1$ B. $\measuredangle 4$

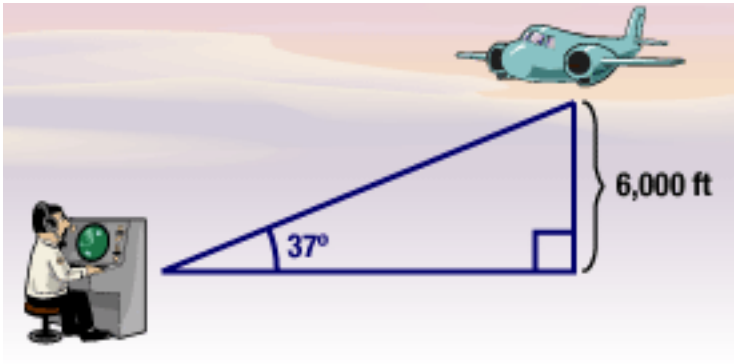


<u>Guided Practice</u>. Use the diagram to classify each angle as an angle of elevation or angle of depression.

4. $\measuredangle 5$ **5.** $\measuredangle 6$



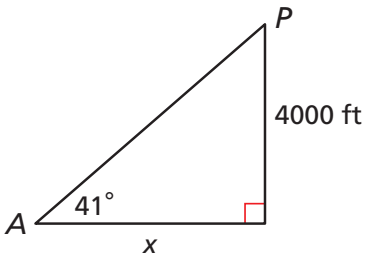
Video Example 2. An air traffic controller at an airport sights a plane at an angle of elevation of 37°. The pilot reports the plane's altitude is 6000 ft. What is the horizontal distance between the plane and the airport? Round your answer to the nearest foot.



2 Finding Distance by Using Angle of Elevation

An air traffic controller at an airport sights a plane at an angle of elevation of 41°. The pilot reports that the plane's altitude is 4000 ft. What is the horizontal distance between the plane and the airport? Round to the nearest foot.

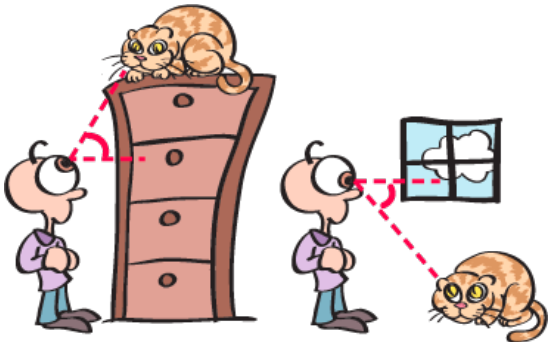
Draw a sketch to represent the given information. Let A represent the airport and let P represent the plane. Let x be the horizontal distance between the plane and the airport.



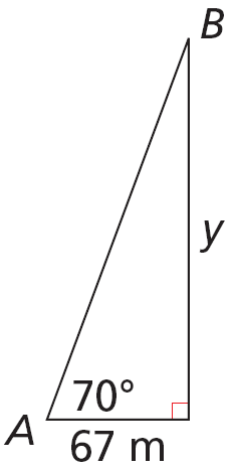
$\tan 41° = \frac{4000}{x}$ *You are given the side opposite ∠A, and x is the side adjacent to ∠A. So write a tangent ratio.*

$x = \frac{4000}{\tan 41°}$ *Multiply both sides by x and divide both sides by tan 41°.*

$x \approx 4601$ ft *Simplify the expression.*

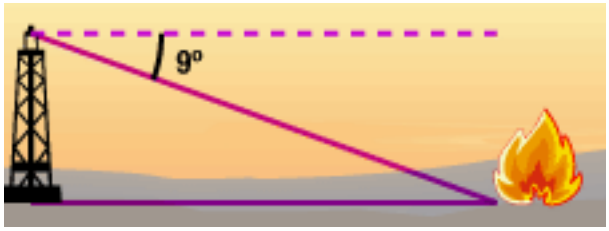


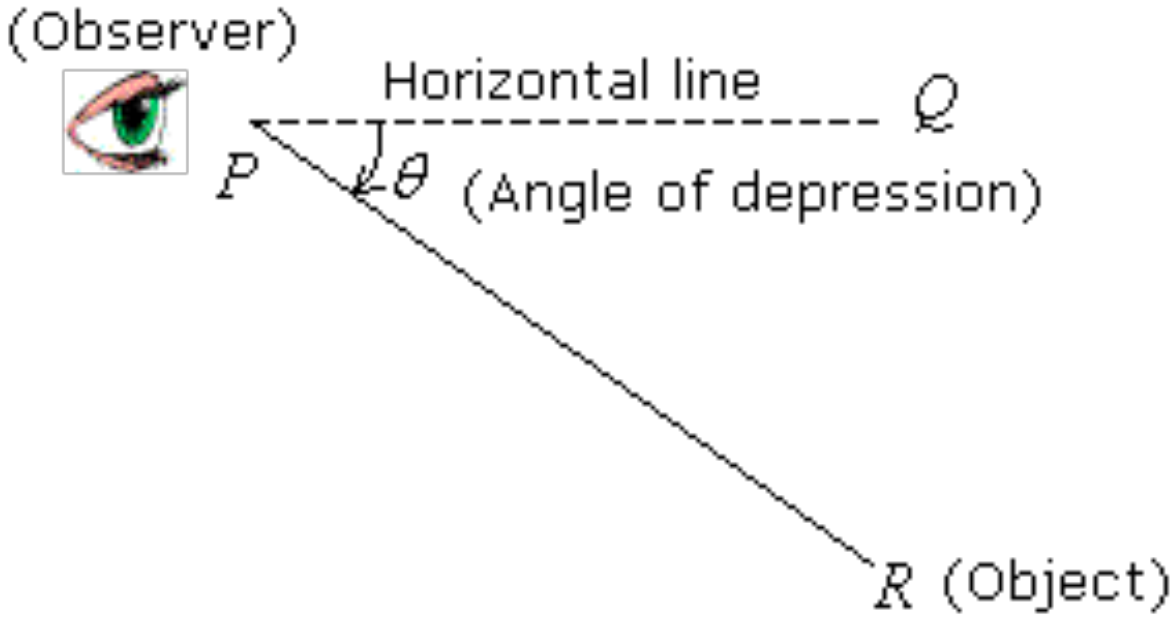
Example 2. The Seattle Space Needle casts a 67-meter shadow. If the angle of elevation from the tip of the shadow to the top of the Space Needle is 70º, how tall is the Space Needle? Round to the nearest meter.



6. Guided Practice. Suppose the plane is at an altitude of 3500 ft and the angle of elevation from the airport to the plane is 29°. What is the horizontal distance between the plane and the airport? Round to the nearest foot.

Video Example 3. A forest ranger is a 70 foot observation tower sees a fire. The angle of depression to the fire is 9°. What is the horizontal distance between the tower and the fire? Round your answer to the nearest foot.

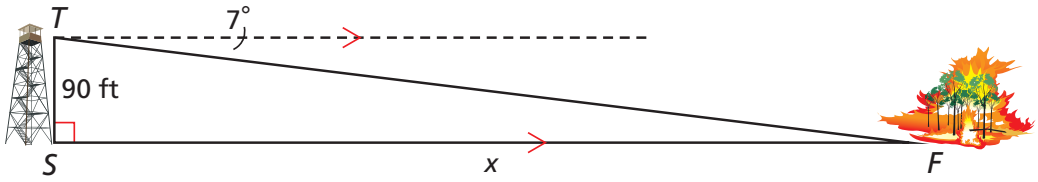




3 Finding Distance by Using Angle of Depression

A forest ranger in a 90-foot observation tower sees a fire. The angle of depression to the fire is 7°. What is the horizontal distance between the tower and the fire? Round to the nearest foot.

Draw a sketch to represent the given information. Let T represent the top of the tower and let F represent the fire. Let x be the horizontal distance between the tower and the fire.



By the Alternate Interior Angles Theorem, $m\angle F = 7°$.

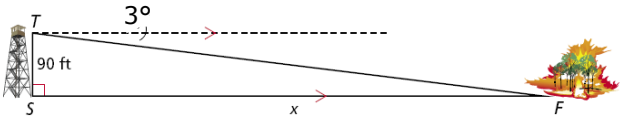
$\tan 7° = \frac{90}{x}$ *Write a tangent ratio.*

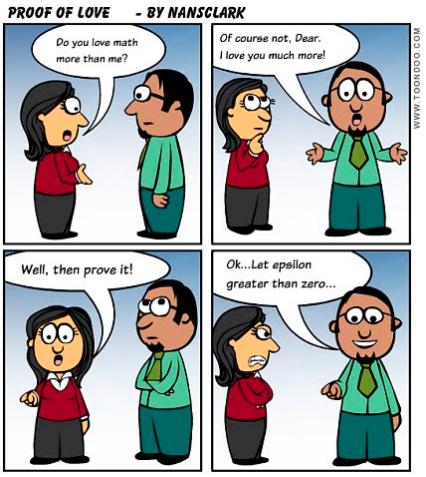
$x = \frac{90}{\tan 7°}$ *Multiply both sides by x and divide both sides by tan 7°.*

$x \approx 733$ ft *Simplify the expression.*

Example 3. An ice climber stands at the edge of a crevasse that is 115 ft wide. The angle of depression from the edge where she stands to the bottom of the opposite side is 52º. How deep is the crevasse at this point? Round to the nearest foot.

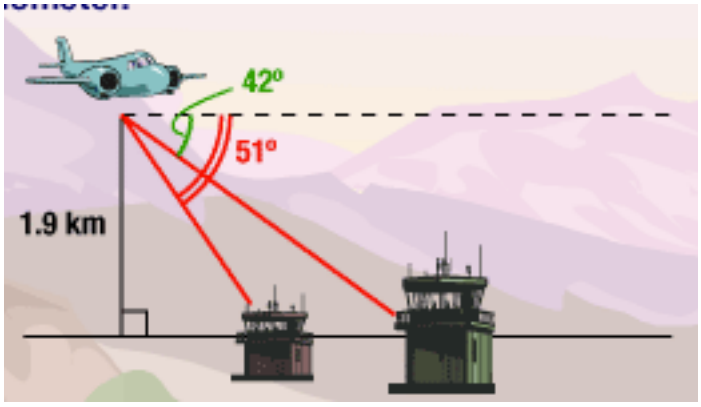
7. Guided Practice. Suppose the ranger sees another fire and the angle of depression to the fire is 3°. What is the horizontal distance to this fire?

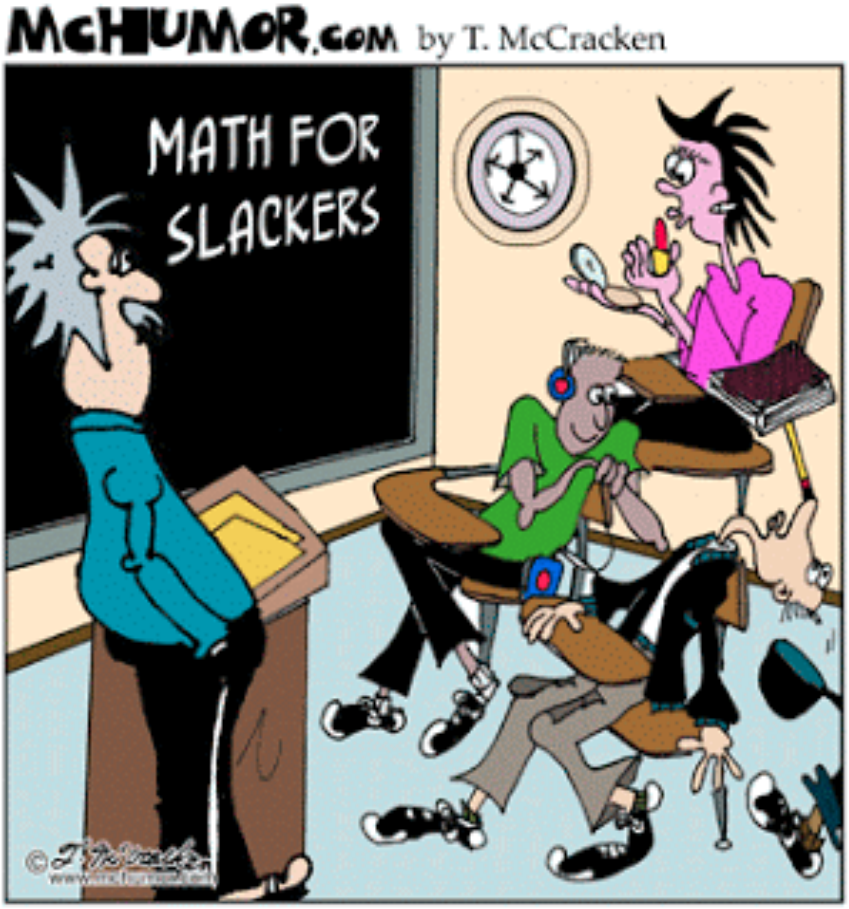




Round to the nearest foot.

Video Example 4. A pilot is flying at an altitude of 1.9 km sights tower control towers directly in front of her. The angle of depression to one tower is $42°$. The angle of depression to the other tower is $51°$. What is the distance between the two towers? Round your answer to the nearest tenth of a km.



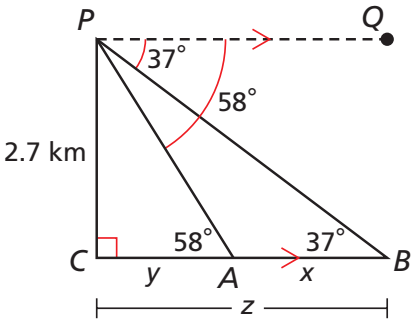


In the Decelerated Math Class
Einstein Learns that Time is Relative.

4 Aviation Application

A pilot flying at an altitude of 2.7 km sights two control towers directly in front of her. The angle of depression to the base of one tower is 37°. The angle of depression to the base of the other tower is 58°. What is the distance between the two towers? Round to the nearest tenth of a kilometer.

Step 1 Draw a sketch. Let P represent the plane and let A and B represent the two towers. Let x be the distance between the towers.



Step 2 Find y.

By the Alternate Interior Angles Theorem, $m\angle CAP = 58°$.

In $\triangle APC$, $\tan 58° = \frac{2.7}{y}$.

So $y = \frac{2.7}{\tan 58°} \approx 1.6871$ km.

Step 3 Find z.

By the Alternate Interior Angles Theorem, $m\angle CBP = 37°$.

In $\triangle BPC$, $\tan 37° = \frac{2.7}{z}$.

So $z = \frac{2.7}{\tan 37°} \approx 3.5830$ km.

Step 4 Find x.

$x = z - y$

$x \approx 3.5830 - 1.6871 \approx 1.9$ km

So the two towers are about 1.9 km apart.

Example 4. An observer in a lighthouse is 69 ft above the water. He sights two boats in the water directly in front of him. The angle of depression to the nearest boat is 48º. The angle of depression to the other boat is 22º. What is the distance between the two boats? Round to the nearest foot.

8. A pilot flying at an altitude of 12,000 ft sights two airports directly in front of him. The angle of depression to one airport is 78°, and the angle of depression to the second airport is 19°. What is the distance between the two airports? Round to the nearest foot.

8-4 Angles of Elevation and Depression (p 565) 11, 13-16, 19, 20, 23-30.